The Glacial Geology of the Wills Creek Basin in Coshocton and Muskingum Counties

Geology 570

Senior Thesis

The Ohio State University

Department of Geology and Mineralogy

by

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Introduction

Purpose

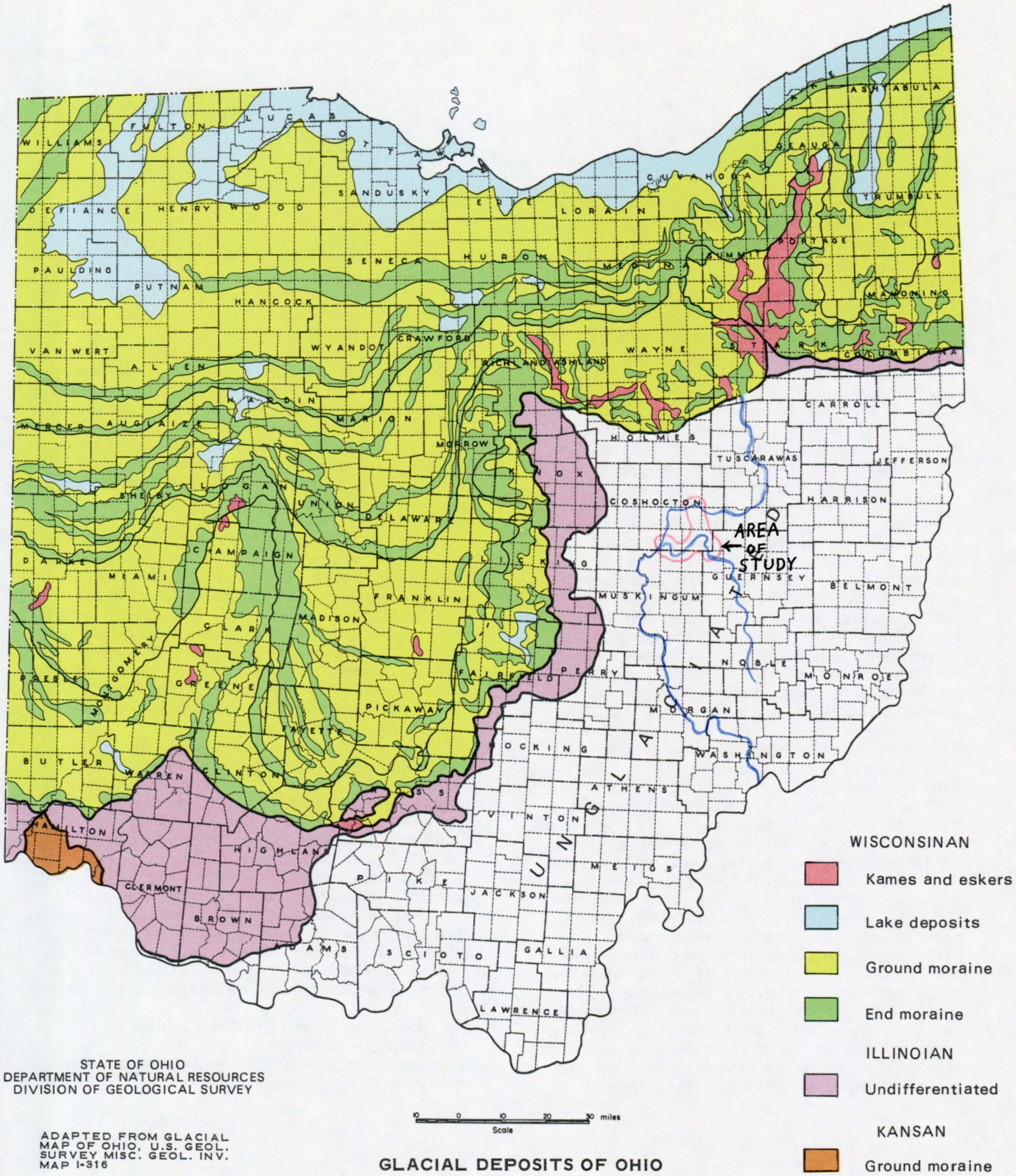
The purpose of this study is to attempt to interpret and explain the drainage changes that have occurred in the Wills Creek Basin during glacial times. Since these changes were caused by Pleistocene glaciation in the region, the interpretation of glacial deposits in the valleys of the Wills Creek Basin were a necessary part of this study. An attempt, therefore, has been made to correlate the age of these glacial deposits with the time of drainage changes.

Location of Area

The area of study is in the Southeastern portion of Coshocton County and northeastern portion of Muskingum County (fig. 1). Wills Creek flows north through Noble and Guernsey Counties. It then flows west and enters the Muskingum River near the border between Coshocton and Muskingum Counties.

Acknowledgments

The writer wishes to acknowledge Dr. Sidney E. White, Department of Geology and Mineralogy, The Ohio State University, for his helpful advice and cooperation. Mrs. Erma Hahn of the United States Soil Conservation Service was helpful in supplying soil maps of the area.



GLACIAL DEPOSITS OF OHIO

Figure 1

GLACIAL MAP OF OHIO

Although perhaps difficult to imagine, Ohio at one time had almost three-quarters of its surface area covered by vast sheets of ice perhaps as much as one mile thick. Ohio has, in fact, been partially covered by great ice sheets at least three and possibly four times in the recent (within the last few million years) geologic past.

Evidence in the geologic record suggests that periods of extensive glaciation extend far into the world's geologic past. The most recent period of glaciation and one which is evident in Ohio is known geologically as the Pleistocene Epoch (11,000 to 2,000,000 years before present). This period of geologic history is also commonly referred to as the Ice Age, although, as stated previously, there were certainly other "ice ages" in the past.

During the Pleistocene, four major ice advances are known to have occurred on the North American continent. These advances, named Nebraskan, Kansan, Illinoian, and Wisconsinan, from oldest to youngest, came from northern Canada and were the result of climatic conditions which allowed massive build-ups of ice. Because of their great thickness these ice masses flowed under their own weight and ultimately moved south as far as northern Kentucky, crossing the Ohio River in the Cincinnati area.

There is no direct evidence that the first ice sheet, the Nebraskan, occupied Ohio. In the Cincinnati region there is one small area of glacial deposits (shown in brown on map) which is considered by some geologists to be of Kansan age. The Illinoian ice sheet (lavender area on map) covered the largest area of Ohio, and its deposits are found from Cincinnati to Youngstown. However, because each major advance covered the deposits left by the previous ice sheets, the features shown on the glacial map are largely the result of the last or Wisconsinan-age glaciers.

The material left by the ice sheets consists of mixtures of clay, sand, gravel, and boulders in various types of deposits of different modes of origin. Rock debris carried along by a glacier was deposited in two principal fashions, either directly by the ice or by meltwater from the glacier. Some material reaching the ice front was carried off by streams of meltwater to form outwash deposits. These deposits normally consist of sand and gravel. Sand and gravel in forms called kames and eskers (shown in red) were deposited by water on and under the surface of the glacier itself and are recognized by characteristic shapes and composition. The distinctive characteristic of glacial debris that has been moved by water is that it was sorted by the water which carried it off. The larger boulder-size particles were left behind while the smaller clay-size particles were carried far away, leaving the intermediate gravel- and sand-size materials along the stream courses.

Boulder- to clay-size material deposited directly from the ice was not sorted. Some of the debris was deposited as ridges parallel to the edge of the glacier itself, forming a terminal or end moraine (shown on map in dark green), which marks the position of the retreating ice when it paused for a period of time, possibly a few hundred years. When the entire ice sheet receded because of melting, much of the ground-up rock material still held in the ice was deposited on the surface as ground moraine (light green on map). The term glacial drift is commonly used to refer to any material deposited at or behind the terminal edge of a glacier. Because the ice which invaded Ohio came from Canada, it carried in many rock types not found in Ohio. Boulders of these foreign rock types are called erratics. Rock collecting in areas covered with glacial drift or in glacial outwash deposits may yield granite, gneiss, trace quantities of gold, and, very rarely, diamonds. The bulk of the rocks found in glacial deposits, however, will be those types native to Ohio.

Many glacial lakes were formed during the time ice covered Ohio. Lake deposits (shown in blue) are primarily very fine-grained clay- and silt-size sediments. The most extensive area of lake deposits is in northern Ohio bordering Lake Erie. These deposits represent early stages in the development of Lake Erie as it is presently known.

Certain deposits left behind by the ice are of economic importance, particularly sand and gravel, clay, and peat. Sand and gravel, which has been sorted by meltwater, is generally found as kames or eskers or as outwash deposits along major drainageways. Sand and gravel is vital to Ohio's construction industry and deposits are abundant within the state.

Glacial clay is used in cement and for common clay products (particularly field tile). The minor quantities of peat produced in the state are used mainly for mulch and soil conditioning.

Officials of the Muskingum Watershed Conservancy District were very cooperative in giving the writer trespassing rights on District Property. Water well records were supplied by the Ohio Department of Natural Resources, Division of Water. A special thanks goes to my wife, Shelley, for the editing and typing of this report.

Previous Studies

Stout, Ver Steeg, and Lamb (1943) briefly describe the changes in drainage of this area. Lamborn (1954) goes into more extensive explanation of drainage changes and reverses along with the glacial history of the area.

Soils

The soils formed in the Wills Creek Basin within the area of study have developed on glacial outwash terraces and floodplains of the streams. These soils have been mapped and identified by the Soil Conservation Service. The following soils are predominant in the area of study:

Allegheny silt loam- formed on stream terraces and old floodplains

Monongahela silt loam- formed on stream terraces and old floodplains

Tyler silt loam- formed on stream terraces and old floodplains

Chili silt loam- formed on glacial outwash (sand and gravel)

Wheeling silt loam- formed on glacial outwash (sand and gravel)

Glenford silt loam- formed on old floodplains

Sebring silt loam- formed on old floodplains

Atkins silt loam- formed on floodplains

Chagrin silt loam- formed on floodplains

Drainage Changes

Pre-Glacial Drainage

Evidence has shown that the drainage pattern in Ohio was quite different before the Ice Age than it is at the present time. The name given by early researchers to this preglacial drainage is the Teays System. Figure 3 shows several of the major streams of the Teays System. The Teays River was the largest stream in Ohio at that time. It flowed northwest into Ohio from West Virginia and entered Indiana where Mercer County is today.

A major tributary in this system was the Cambridge River (Stout, et. al., 1943). It flowed for much of its course in the valley of the present day Wills Creek. Starting in Noble County and flowing north the Cambridge River turned west and entered the southeast corner of Coshocton County. At Plainfield the stream turned north and flowed to West Lafayette where it entered the valley of the present day Tuscarawas River (Plate 1). From there it flowed west to Coshocton, then south through the valley of the present day Muskingum River. The Cambridge River emptied into the preglacial Groveport River at Newark (Stout, et. al., 1943) (fig. 3). Between Plainfield and Cambridge the valley of the Cambridge River was unobstructed by glacial debris. It is here that the meandering Wills Creek reflects the age of the

preglacial valley. The valley has a wide extensive floodplain with meander scars and oxbow lakes (fig. 2).

Figure 2. The preglacial valley of Wills Creek east of Plainfield.

At West Lafayette the Cambridge River was met by Newcomerstown Creek (Stout, et. al., 1943), which headed in Tuscarawas County and flowed west through the valley of the present day Tuscarawas River (fig. 3 and plate 1).

The valley of the present day Wills Creek between Plainfield and the Muskingum River was occupied by two streams flowing in opposite directions during preglacial time. One stream headed east of the preglacial divide near Maysville (plate 1) and flowed eastward to join the northward-flowing preglacial White Eyes Creek which entered the Cambridge River at Plainfield. The other stream also headed near Maysville west of the preglacial

OHIO

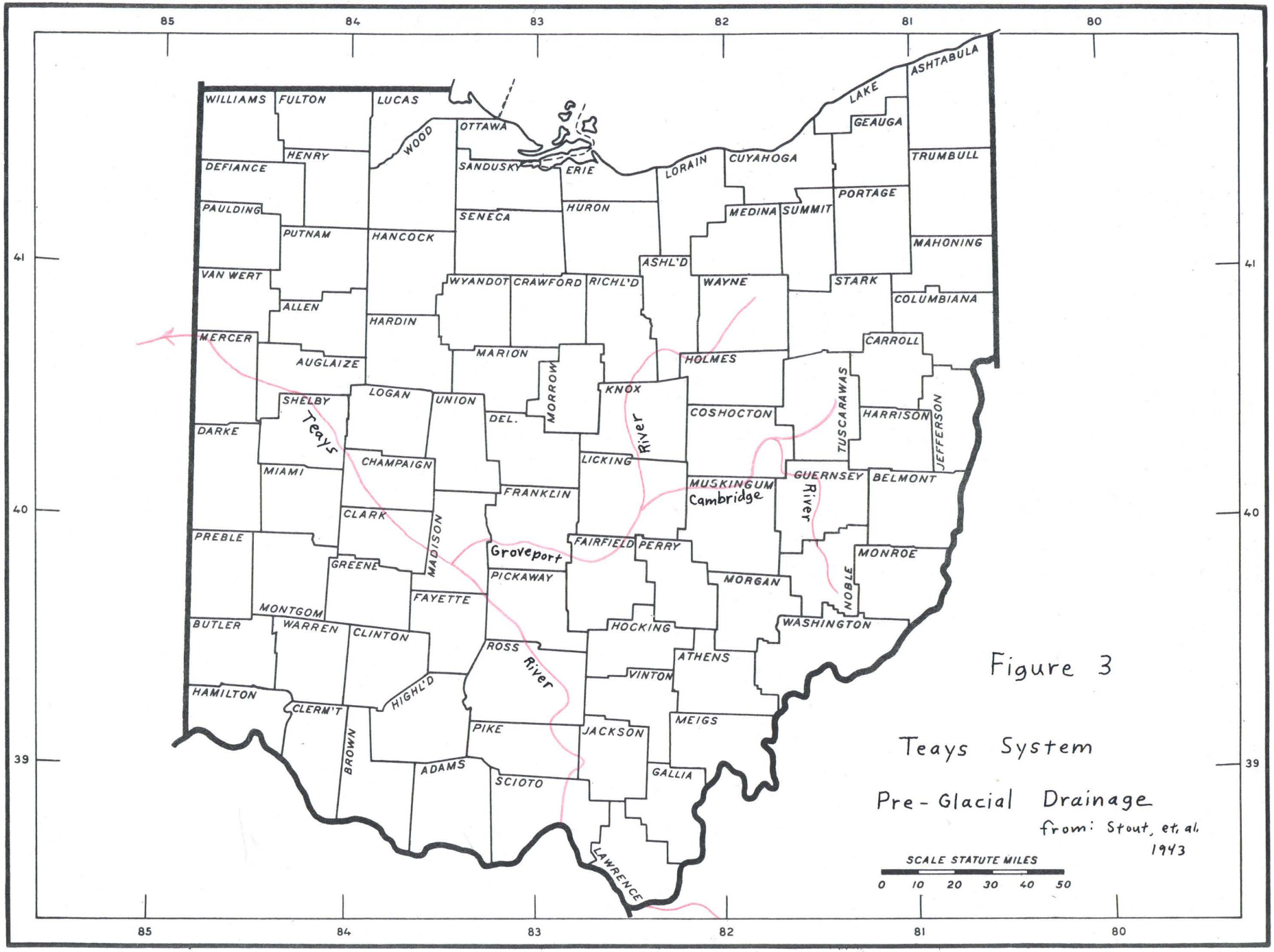


Figure 3

Teays System

Pre-Glacial Drainage

from: Stout, et. al. 1943

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divide (plate 1) and flowed westward to enter the Cambridge River just south of Conesville. Lamborn (1954, p. 16) states that the stream flowing west of the divide, which he called Franklin Creek, flowed through the town of Wills Creek and entered the Cambridge River north of Conesville. There is no definite topographic evidence to support this claim. The width of the mouth of present day Wills Creek (plate 1) convinces the writer that this part of the valley (from the town of Wills Creek to the Muskingum River) was occupied by the preglacial stream.

Deep Stage Drainage

Earlier publications have referred to the pre-Illinoian glacial drainage changes in Ohio as the Deep Stage. There is evidence in other parts of Ohio that a pre-Illinoian glacier (Kansan?) blocked the northwestward flow of the preglacial Teays system. The result was large scale flooding of valleys and reversal of drainage to the south. This glacier appears to have had little effect on the drainage in the Wills Creek Basin.

Evidence beyond the scope of this study shows that the old preglacial divide in Tuscarawas County that separated Newcomerstown Creek from a northward-flowing stream was breached during the pre-Illinoian glacier. This elongated stream, referred to as the Newark River (Stout, et. al., 1943), flowed from its source below

the ice margin in Stark County through the valley of the present day Tuscarawas River, turned south at Coshocton, and flowed to the southwest through Newark before entering the valley of the present Scioto River. The Newark River became the principal stream in this area during the pre-Illinoian glacial stage.

The major tributary to the Newark River was Plainfield Creek (Stout, et. al., 1943) which followed the course of the preglacial Cambridge River and joined the Newark River at West Lafayette. The other streams in the system continued to follow their preglacial courses.

At the end of the pre-Illinoian glacial stage there was very rapid downcutting of the stream valleys in Ohio. This severe erosion is thought to have been the result of regional uplift. The term Deep Stage has been applied to this intrenched valley system because the valley floors were eroded much lower than preglacial levels. An example of the depth of the Deep Stage erosion is shown by wells drilled in the floodplain of the Tuscarawas River. The Deep Stage surface is found to range from 150 to 175 feet below the present day valley floor (Lamborn, 1954, p. 17).

Well records in the valley of Plainfield Creek indicate that the Deep Stage surface ranges between 100 and 150 feet below the present valley floor of Wills Creek. These records indicate that the gradient of Plainfield Creek was about 1.8 feet per mile in the

same direction as the preglacial Cambridge River (Lamborn, 1954, p. 18). Well records indicate that Deep Stage White Eyes Creek (150 feet below present valley floor) followed the same course as preglacial White Eyes Creek (Lamborn, 1954, p. 19). Test wells drilled by the Corps of Engineers show that the preglacial drainage divide at Maysville (plate 1) remained the same during the Deep Stage.

Illinoian Glacial Drainage

The advance of the Illinoian glacier 180,000 years ago (Quinn, 1974) had little if any effect on the Wills Creek Basin. The Newark River was blocked several miles east of Newark by the ice. This caused the water in the Newark River system to flood the stream valleys. As the ponded water continued to rise a divide at the Muskingum-Morgan County line was breached and the present day Tuscarawas and Muskingum Rivers were created. This escape for the ponded water allowed the streams in the area of study to resume the pre-Illinoian drainage pattern. There was probable deposition of lacustrine silts and clays of Illinoian age during the period of ponding. However, these sediments have either been eroded or buried by deposits of younger age.

Wisconsin Glacial Drainage Changes

The Early Wisconsin glacier had a very marked effect on the Wills Creek Basin. This glacial advance took place

in Ohio about 70,000 years ago (Dreimanis and Goldthwait, 1973). Melt water from the Early Wisconsin ice flowed down the Tuscarawas River. Outwash was carried along with the melt water and deposited in the valley. The sand and gravel making up this valley train blocked the mouth of Plainfield Creek at West Lafayette (plate 1). The northward-flowing water flooded the valleys in the area south of West Lafayette. The divide at Maysville was breached and the ponded water flowed west and entered the Muskingum River south of Conesville, creating the present day Wills Creek. With this drainage diversion part of the meltwater coming down the Tuscarawas River flowed through the valley between West Lafayette and Plainfield depositing more outwash. After the retreat of the Early Wisconsin glacier about 53,000 years ago (Dreimanis and Goldthwait, 1973), the sand and gravel in this portion of the valley acted as a divide between the Tuscarawas River and Wills Creek. The subsequent Middle and Late Wisconsin glaciers had no effect on the Wills Creek Basin. The valley fill between West Lafayette and Plainfield prevented deposits of the younger glaciers from entering Wills Creek.

Outwash Deposits of Wills Creek

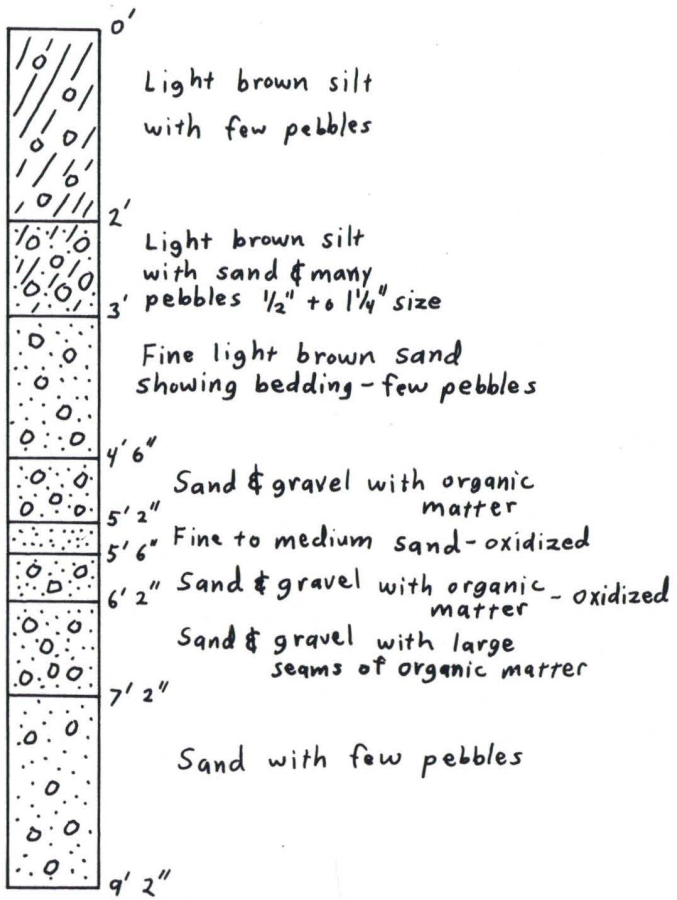
West Lafayette- Plainfield Outwash

The glacial outwash deposits in the Wills Creek Basin are of Early Wisconsin age. The distribution of these deposits is shown in plate 1. After the erosion of the divide at Maysville the melt water moving down the valley from West Lafayette deposited sand and gravel in the valley of Wills Creek downstream from Plainfield. This material can be traced all the way to the Muskingum River. Post-glacial erosion has left the outwash deposits in the form of valley terraces. The West Lafayette-Plainfield outwash exists as the valley fill between West Lafayette and Plainfield. Here the sand and gravel is at least 180 feet thick (fig. 7). Material of this level also exists as terraces in the valley of Wills Creek east and south of Plainfield. The stratigraphy of the West Lafayette-Plainfield outwash is shown in figure 4. This section shows a road cut where the upper 9 feet of a terrace is exposed. Well logs indicate the stratigraphy at different points throughout the valley (fig. 6, wells #1 through #6).

The depth of leaching of carbonates in the outwash exposed at the road cut was in excess of 9 feet. The depth of leaching in deposits of Early Wisconsin age in the Licking River valley is 10 feet (Jones, 1959, p. 20). Middle Wisconsin sediments show a leaching

Figure 4 Stratigraphic Section

of West Lafayette - Plainfield Outwash Terrace at road cut southwest of Plainfield



Interbedding of sand, gravel, and organic matter in West Lafayette - Plainfield outwash.

of 3 to 4 feet (Jones, 1959, pp. 26 and 29). Auger borings in other locations show leaching in excess of 5 feet in the Wills Creek valley. With this evidence the writer has determined the West Lafayette-Plainfield outwash to be Early Wisconsin in age.

Cut Terraces

Eroded remnants (cut terraces) of West Lafayette-Plainfield outwash are distributed throughout the Wills Creek valley from Plainfield to the Muskingum River. Auger borings indicate that these terraces, covered by thick deposits of silt, are remnants of the West Lafayette-Plainfield surface. They occur in the valley at a lower elevation than the original terraces (plate 2) and (fig. 8 and 9).

Figure 5. Outwash of the West Lafayette-Plainfield terrace showing cross-bedding.

Well Logs
Sandy clay
clay
gravel
Sand & gravel
Sand
Well # 1
West Lafayette
0
44'
65'
78'
85'
100'
120'
Well # 2
West Lafayette
0
100'
Well # 3
north of Plainfield
0
25'
30'
175'
180'
Well # 4
Plainfield
0
35'
70'
110'
117'
127'
130'
Well # 5
east of Plainfield
0
26'
32'
37'
57'
62'
68'
72'
88'
91'
101'
107'
112'
120'
Well # 6
east of Plainfield
0
4'
16'
68'
Well # 7
west of Willis Creek
0
94'

Figure 6

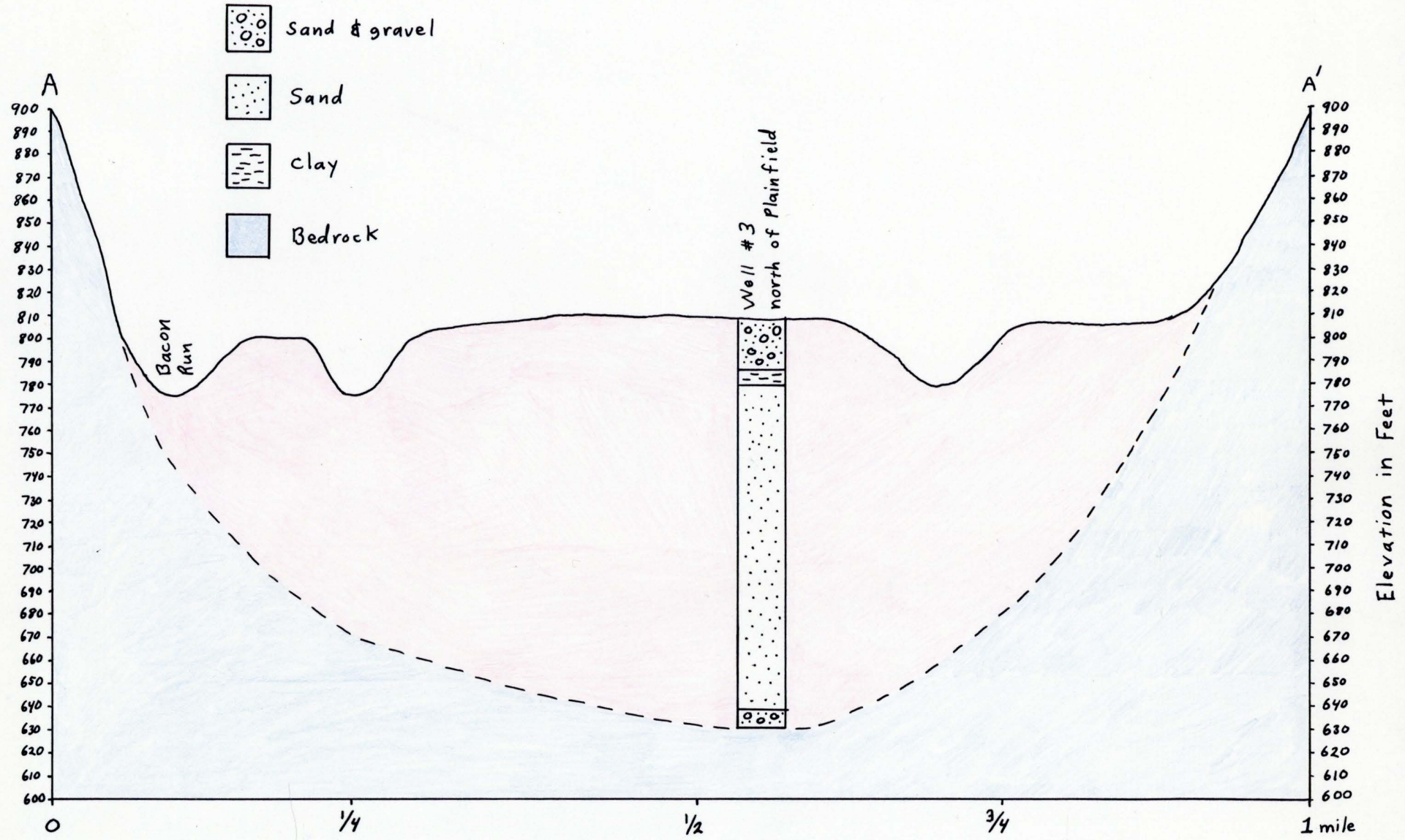


Figure 7

Cross-section of filled pre-glacial valley north of Plainfield

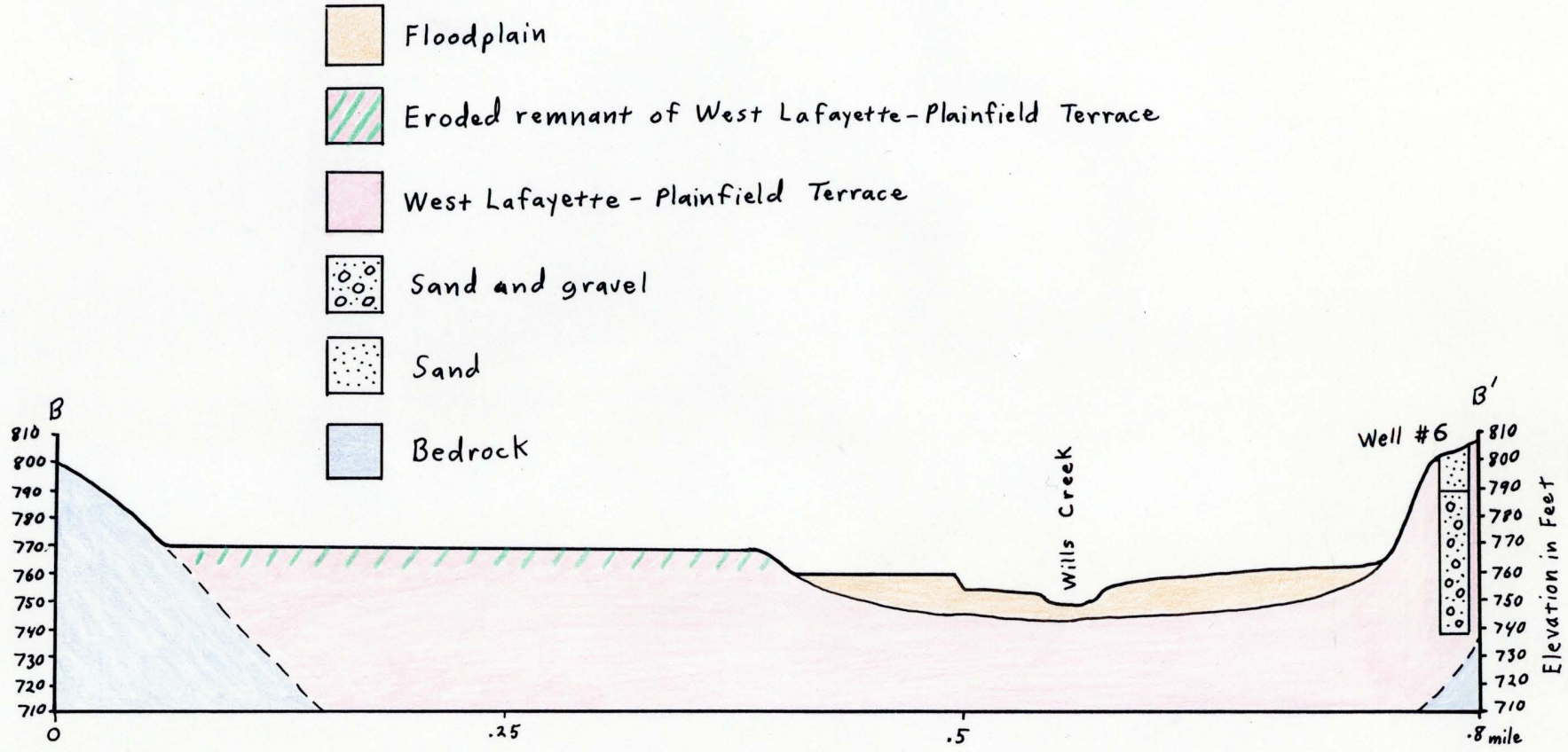


Figure 8

Cross - section of Wills Creek Valley east of Plainfield

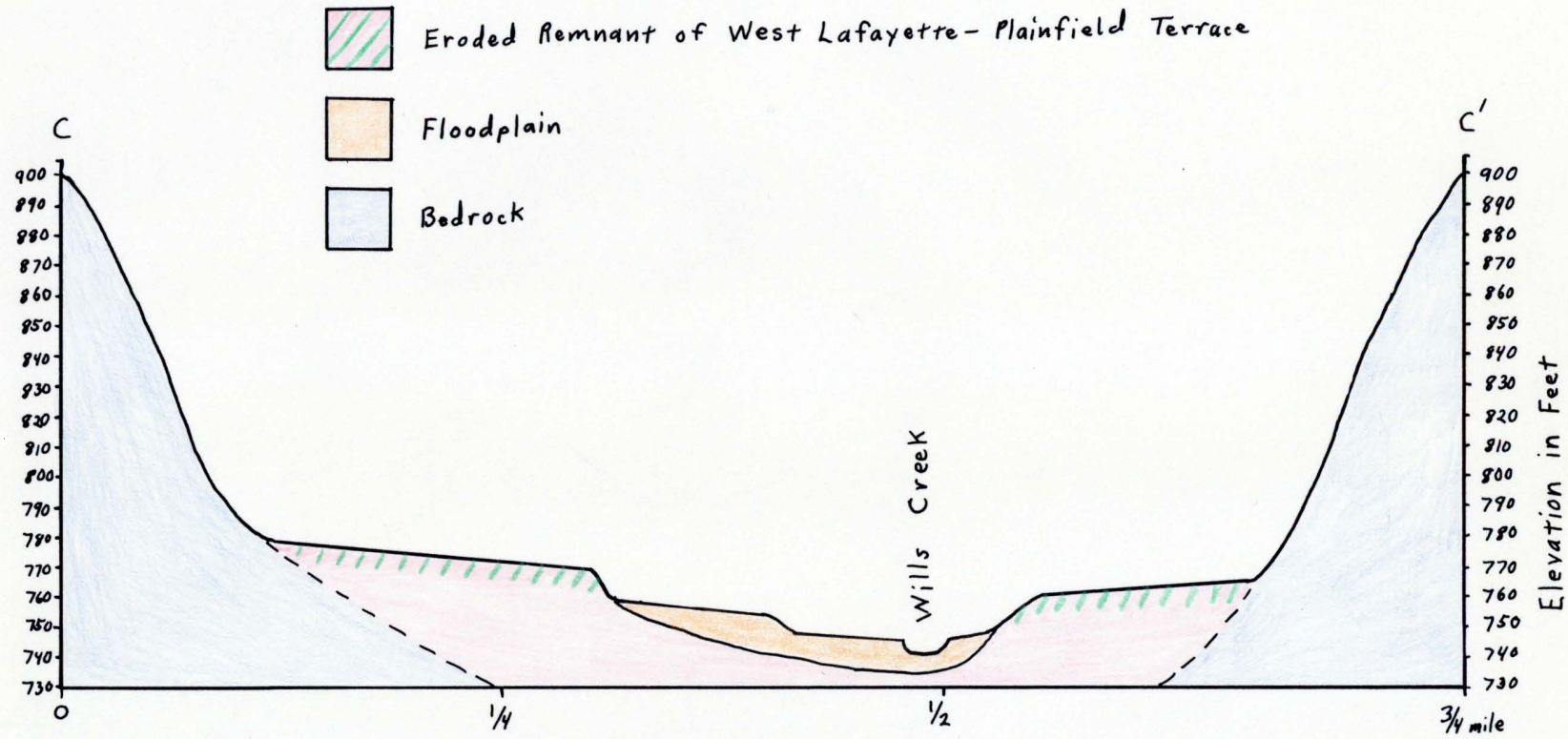


Figure 9

Cross-section of Wills Creek Valley southwest of Plainfield

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